Coastal Protection and Restoration Authority of Louisiana

Office of Coastal Protection and Restoration

2008 Annual Inspection Report

for

DELTA MANAGEMENT AT FORT ST. PHILLIP (BS-11)

State Project Number BS-11
Priority Project List PPL-10

April 15, 2008
Plaquemines Parish

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I. Introduction

Delta Management at Fort St. Phillip (BS-11) was authorized by Section 303(a) of Title III Public Law 101-646, the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) enacted on November 29, 1990 as amended. The Delta Management at Fort St. Phillip Project was approved on the sixth (10^{th}) Priority Project List and the project area is located within two separate areas, both in Plaquemines Parish, La. The western most area (Area 1) is just north of Fort St. Phillip in Bay Denesse consists of three new crevasses and 19,500 linear feet of terraces. The other area (Area 2), made up of 3 crevasses, is approximately 4.5 mile east of Area 1 in the vicinity of Little Coquille Bay. Both areas are fed by over-bank flow from the Lower Mississippi River just across the river from Fort Jackson.
The necessary agreements to allow project construction and operation to proceed have been executed between OCPR and the U.S. Fish and Wildlife Service (USFWS).

II. Inspection Purpose and Procedures

The purpose of the annual inspection of the Delta Management at Fort St. Phillip (BS-11) is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of the project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, OCPR shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs (O&M Plan May 13, 2007). The annual inspection report also contains a summary of maintenance projects and an estimated projected budget for the upcoming three (3) years for operation, maintenance and rehabilitation. The three (3) year projected operation and maintenance budget is shown in Appendix C. The summary of any past maintenance projects completed since completion of the initial construction of the Delta Management at Fort St. Phillip Project in 2006 will be outlined in Section IV.

This initial annual inspection of the Delta Management at Fort St. Phillip Project (BS-11) was held on March 13, 2008 on a clear to partly cloudy and cool day with winds NW 10 to 15 mph. At the time of the inspection, 11:00AM, the Mississippi River Gage at the Venice, La. station was +3.5 feet NGVD. In attendance were Tom Bernard and Melissa Hymel, OCPR; and Kevin Roy, USFWS. Due to the spread out and remote locations of the crevasses and the possibility of low tides in the terrace location, the three member inspection team choose to use air-boat transportation for the inspection. Photographs of that inspection are included in Appendix B of this report. Arial photographs taken on the day following the inspection were also included in Appendix B.

III. Project Description and History

This project was constructed in two areas near Fort St. Phillip, on the east side of the Mississippi River across the river from Fort Jackson in Plaquemines Parish. Area 1 consists of 174 acres of emergent marsh and 678 acres of open water. Area 2 contains three triangular-shaped areas and consists of 126 acres of emergent marsh and 327 acres of open water. This project is intended to enhance marsh growth by diverting fresh water and sediment through constructed crevasses into shallow, open-water receiving areas. Earthen terraces were also constructed in Area 1 to further trap sediments, promote marsh-building processes, and offset land loss.

The Project has twenty-year (20 year) economic life, which began in 2006.

The principal project features include:

- Terraces: 98 terraces, 200 ft. in length, 10 ft. crown width, 52 ft. base width

- Crevasse 1A: 2000 ft. x 75 ft. x -8.0 ft. NAVD 88
- Crevasse 1B: 400 ft. x 75 ft. x -6.0 ft. NAVD 88
- Crevasse 1C: 700 ft. x 75 ft. x -6.0 ft. NAVD 88
- Crevasse Alt.2A: 732 ft. x 75 ft. x -8.0 ft. NAVD 88
- Crevasse 2B: 500 ft. x 75 ft. x -6.0 ft. NAVD 88
- Crevasse 2C: 2000 ft. x 75 ft. x -6.0 ft. NAVD 88

A. **Terraces –** Project Area 1. 98 terraces, each 200 ft. in length, with a crown width of 10 ft., tapering at a slope of 1 vertical to 6 horizontal to a base width of 52 ft., with 50 ft. separation between ends of terraces. Aggregate length of terraces is 19,500 linear ft. Terraces were built to an initial elevation of +3.5 ft. NAVD 88, with a target settled elevation of +3.0 ft. NAVD 88. Minimum distance to shoreline was 50 ft. and minimum pipeline clearance was 50 ft. Within these constraints, the locations of individual terraces were left to the discretion of the construction manager. In order to maintain a minimum clearance of 50 ft. from the existing pipelines, three of the terraces were each reduced slightly for a total of 100 ft. which made a total of 19,500 linear ft. constructed.

Terraces are not subject to maintenance or rehabilitation under the Cost Sharing Agreement or permits. The above information is provided as a record of project post-construction conditions. OCPR anticipates that the condition of terraces will be observed during annual inspection visits.

Vegetative plantings on the terraces were undertaken through a contract separate from the construction contract and are not subject to maintenance

or rehabilitation by OCPR or USFWS.

B. **Crevasse 1A –** Project Area 1. 2000 ft. long x 75 ft. base width x -8.0 ft. NAVD 88. Marsh elevation was assumed to be +1.5 ft. NAVD 88. The crevasse was dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,875,963.63 ft., Y = 322,516.09 ft. NAD 83), and extends along a bearing of N47^{o}W. Dredge material was placed within 175 ft. no closer than 25 ft. on either side of the crevasse to a maximum elevation of +5.0 ft. NAVD 88.

C. **Crevasse 1B –** Project Area 1. 400 ft. long x 75 ft. base width x -6.0 ft. NAVD 88. Marsh elevation was assumed to be +1.5 ft. NAVD 88. The crevasse was dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,875,557.544 ft., Y = 320,705.6253 ft. NAD 83), and extends along a bearing of N22^{o}W. Dredge material was placed within 175 ft. no closer than 25 ft. on either side of the crevasse to a maximum elevation of +5.0 ft. NAVD 88.

D. **Crevasse 1C –** Project Area 1. 700 ft. long x 75 ft. base width x -6.0 ft. NAVD 88. Marsh elevation was assumed to be +1.5 ft. NAVD 88. The crevasse was dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,873,382.42 ft., Y = 320,246.83 ft. NAD 83), and extends along a bearing of S77^{o}W. Dredge material was placed within 175 ft. no closer than 25 ft. on either side of the crevasse to a maximum elevation of +5.0 ft. NAVD 88

E. **Crevasse Alt. 2A –** Project Area 2. 732 ft. long x 75 ft. base width x -8.0 ft. NAVD 88. Marsh elevation was assumed to be +1.5 ft. NAVD 88. The crevasse was dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,891,269.92 ft., Y = 322,243.99 ft. NAD 83), and extends along a bearing of N50^{o}E. Dredge material was placed within 175 ft. no closer than 25 ft. on either side

F. **Crevasse 2B –** Project Area 2. 500 ft. long x 75 ft. base width x -6.0 ft. NAVD 88. Marsh elevation was assumed to be +1.5 ft. NAVD 88. The crevasse was dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,888,519.61 ft., Y = 320,569.13 ft. NAD 83), and extends along a bearing of S69^{o}E. Dredge material was placed within 175 ft. no closer than 25 ft. on either side of the crevasse to a maximum elevation of +5.0 ft. NAVD 88.

G. Crevasse 2C – Project Area 2. 2000 ft. long x 75 ft. base width x -6.0 ft. NAVD 88. Marsh elevation was assumed to be +1.5 ft. NAVD 88. The crevasse was dredged from the center of the channel, passes through a reference point defined by the pre-construction shoreline (X = 3,891,138.38 ft., Y = 321,807.44 ft. NAD 83), and extends along a bearing of S77^{o}E. Dredge material was placed within 175 ft. no closer then 25 ft. on either side of the crevasse to a maximum elevation of +5.0 ft. NAVD 88.

Those project features were covered by this inspection are inclusive of and are identified as the Delta Management at Fort St. Phillip (BS-11). The intention of the annual inspection is to maintain the project in a condition that will generally provide the anticipated benefits that the project was based on. There is no requirement that this project function to any standard beyond the 20-year economic life; except that it is not left as a hazard to navigation or a detriment to the environment. A site map showing the project boundary within the Delta Management at Fort St. Phillip project benefit area is shown in Attachment II along with a map identifying all of the project features within the project area.

IV. Summary of Past Maintenance Projects

There has been no past maintenance on this Project (BS-11)

V. Inspection Results for Crevasses Dredged in 2006 (See Appendix B for Project Photos)

A. Terraces: The terraces have held up very well since they were costructed in the fall of 2006. There are a few that were built on the north side with soft / unsuitable material that have developed some washout areas in their perimeter; however, most of the terraces are in excellent condition and have vegetated heavily since the time that they were planted. Tides and the river were very high at the time of the inspection, but the terrace heights above the bay showed that they had maintained mostly all of their original elevations. Swift current containing large amounts of river sediments are obvious throughout the terrace field.

B. Crevasse No. 1A: This crevasse is the longest of all and feeds river water directly into Bay Denesse where the terraces were constructed. Currents through this crevasse were swift and appeared to be carrying plenty river sediments into the terrace area. Soundings showed good depth throughout the length of the crevass and the crevasse spoil was well vegetated.

C. Crevasse No. 1B: This crevasse, which is the shortest of all, feeds a small area of marsh. Soundings through its length indicate good water depth throughout.

Currents through this cut were swift, carrying plenty river sediments. The spoil banks appeared to be very heavily vegetated.

D. Crevasse No. 1C: Good flow is being maintained by this crevasse. Soundings indicate good water depth is being maintained throughout its length. Strong current is also being maintained carrying much needed river sediments into the bays. Dredge spoil from the crevasse has vegetated nicely.

E. Crevasse No. Alt.2A: This crevasse maintains a good flow throughout its length. It has maintained its depth through along its length and appears to be carrying much needed river sediments into the interior marsh areas.

F. Crevasse No. 2B: Currents are moderate to high in this crevasse. There is obvious evidence of sediments are being carried into the marsh areas, and the spoil from the crevasse excavation has vegetated very heavily. This crevasse has also maintained it original depth throughout.

G. Crevasse No. 2C: This crevasse is also one of the longest of the project and soundings show that it has maintained its constructed depth through its length. The spoil form the crevasse excavation has vegetated very nicely and there is plenty current to carry river sediments into the interior marsh areas.

VI. Conclusions and recommendations

As a result of the inspection, the inspection team concluded that all project features are functioning as designed and should continue to do so without any immediate maintenance. Therefore; it is recommended that no action be taken for maintenance at this time.

APPENDIX "A"
Project Features Map

APPENDIX B

Photographs

Terrace Field in Bay Denesse (View 1)

Terrace Field in Bay Denesse (View 2)

Terrace Field (View 3)

Terrace Field (View 4)

Surface View of terrace Field

Surface View of Terrace Field

View of Terrace Slightly Eroded

Heavy Vegetation on Terrace

Looking Down a Heavily Vegetated Terrace

Crevasse No. 1A

Crevasse No. 1B

Crevasse No. 1A Spoil Area

Crevasse No. 1C

Crevasse No. 2A

Crevasse No. 2B

Crevasse No. 2C

Appendix C
Three-Year Operation & Maintenance Budgets

2008 Annual Inspection Report
DELTA MANAGEENT AT FORT ST. PHILLIP
State Project No. BS-11

Delta Management at Fort St. Phillip / BS-11 / PPL 10

Three-Year Operations & Maintenance Budgets 07/01/2008 - 06/30/2011

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Project	O & M	Federal Sponsor	Prepared By
Tom Bernard	*Tom Bernard*	USFW	*Tom Bernard*

	2008/2009	2009/2010	2010/2011
Maintenance Inspection	$4,617.00	$4,737.04	$4,860.21
General Maintenance	$0.0	$0.0	$0.0
Structure Operation	$0.0	$0.0	$0.0
Administration	$0.0	$0.0	$0.0
Maintenance/Rehabilitation			

07/08 Description:

E&D	$0.0
Construction	$0.0
Construction Oversight	$0.0
Sub Total - Maint. And Rehab.	$ -

08/09 Description

E&D		$0.0
Construction		$0.0
Construction Oversight		$0.0
	Sub Total - Maint. And Rehab.	$ -

09/10 Description:

E&D			$0.0
Construction			$0.0
Construction Oversight			$0.0
		Sub Total - Maint. And Rehab.	$ -

	2008/2009	2009/2010	2010/2011
Total O&M Budgets	**$ 4,617.00**	**$ 4,737.04**	**$ 4,860.21**

O &M Budget (3 yr	**$ 14,214.25**
Unexpended O & M Budget	**$ 841,706.00**
Remaining O & M Budget (Projected)	**$ 827,491.75**

OPERATION AND MAINTENANCE BUDGET WORKSHEET 2007/2008

Delta Management at Fort St. Phillip / BS-11 / PPL 10

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EAC	1	$4,290.00	**$4,401.00**
General Structure Maintenance	LUM	1	$0.00	**$0.00**
Engineering and Design	LUM	1	$0.00	**$0.00**
Operations	LUM	1	$0.00	**$0.00**
Construction Oversight	LUM	1	$0.00	**$0.00**
ADMINISTRATION				
OCPR / CRD	LUM	1	$0.00	$0.00
FEDERAL SPONSER Admin.	LUM	0	$0.00	$0.00
SURVEY	LUM	1	$0.00	$0.00
OTHE				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary	EAC	0	$0.00	$0.00
Staff Gauge / Recorders	EAC	0	$0.00	$0.00
Marsh Elevation / Topography	LUM	0	$0.00	$0.00
TBM Installation	EAC	0	$0.00	$0.00
OTHE				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:				
Borings	EAC	0	$0.00	$0.00
OTHE				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TON	UNIT	
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ	0	$0.00	$0.00
Navagation Aid		EAC	0	$0.00	$0.00
Signage		EAC	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUM	1	$0.00	$0.00
Materials		LUM	1	$0.00	$0.00
Mob /		LUM	1	$0.00	$0.00
Contingency		LUM	1	$0.00	$0.00
General Structure Maintenance		LUM	1	$0.00	$0.00
OTHE				$0.00	$0.00
OTHE				$0.00	$0.00
OTHE				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$4,401.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET 2008/2009

Delta Management at Fort St. Phillip / BS-11 / PPL 10

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EAC	1	$4,401.00	**$4,516.00**
General Structure Maintenance	LUM	1	$0.00	**$0.00**
Engineering and Design	LUM	1	$0.00	**$0.00**
Operations	LUM	1	$0.00	**$0.00**
Construction Oversight	LUM	1	$0.00	**$0.00**
ADMINISTRATION				
OCPR / CRD	LUM	0	$0.00	$0.00
FEDERAL SPONSER Admin.	LUM	0	$0.00	$0.00
SURVEY	LUM	0	$0.00	$0.00
OTHE				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary	EAC	0	$0.00	$0.00
Staff Gauge / Recorders	EAC	0	$0.00	$0.00
Marsh Elevation / Topography	LUM	0	$0.00	$0.00
TBM Installation	EAC	0	$0.00	$0.00
OTHE				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:				
Borings	EAC	0	$0.00	$0.00
OTHE				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TON	UNIT	
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ	0	$0.00	$0.00
Navagation Aid		EAC	0	$0.00	$0.00
Signage		EAC	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUM	1	$0.00	$0.00
Materials		LUM	1	$0.00	$0.00
Mob /		LUM	1	$0.00	$0.00
Contingency		LUM	1	$0.00	$0.00
General Structure Maintenance		LUM	1	$0.00	$0.00
OTHE				$0.00	$0.00
OTHE				$0.00	$0.00
OTHE				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$4,516.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET 2009/2010

Delta Management at Fort St. Phillip / BS-11 / PPL 10

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EAC	1	$4,516.00	**$4,633.00**
General Structure Maintenance	LUM	1	$0.00	**$0.00**
Engineering and Design	LUM	1	$0.00	**$0.00**
Operations	LUM	1	$0.00	**$0.00**
Construction Oversight	LUM	1	$0.00	**$0.00**
ADMINISTRATION				
OCPR / CRD	LUM	0	$0.00	$0.00
FEDERAL SPONSER Admin.	LUM	0	$0.00	$0.00
SURVEY	LUM	0	$0.00	$0.00
OTHE				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary	EAC	0	$0.00	$0.00
Staff Gauge / Recorders	EAC	0	$0.00	$0.00
Marsh Elevation / Topography	LUM	0	$0.00	$0.00
TBM Installation	EAC	0	$0.00	$0.00
OTHE				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EAC	0	$0.00	$0.00
OTHE				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TON	UNIT	
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ	0	$0.00	$0.00
Navagation Aid		EAC	0	$0.00	$0.00
Signage		EAC	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUM	1	$0.00	$0.00
Materials		LUM	1	$0.00	$0.00
Mob /		LUM	1	$0.00	$0.00
Contingency		LUM	1	$0.00	$0.00
General Structure Maintenance		LUM	1	$0.00	$0.00
OTHE				$0.00	$0.00
OTHE				$0.00	$0.00
OTHE				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$4,633.00**

Appendix D
Field Inspection Form

FIELD INSPECTION CHECK SHEET

Project No. / Name:	Delta Mgt. at Ft. St. Phillip, BS-11	Date of Inspection:	March 13, 2008 Time: 11:00 AM
Crevasse No.	**See Report Section III**	Inspector(s):	LDNR: Tom Bernard, Melissa Hymel-USFWS: Kevin Roy
Crev. / Terr. Specs.	See Report Section III	Water Level:	3.5 NGVD at Venice, La. 11:00 AM
Type of Inspection:	2008 Annual Inspection	Weather Conditions:	Clear to Ptly. Cloudy & Cool, Wind NW 10-15 mph

Item	Condition	Physical Damage	Dimensions	Photo	Observations and Remarks
Crevasse # 1A	Very Good	None	2,000 ft X 75 ft by 8.0' NAVD 88	Appendix B	This crevasse is the longest of all and feeds river water directly into Bay Denesse where the terraces were constructed. Currents through this crevasse were swift and appeared to be carrying plenty river sediments into the terrace area. Soundings showed good depth throughout the length of the crevass and the crevasse spoil was well vegetated.
Crevasse # 1B	Very Good	None	400 ft X 75 ft by 6.0' NAVD 88	Appendix B	This crevasse, which is the shortest of all, feeds a small area of marsh. Soundings through its length indicate good water depth throughout. Currents through this cut were swift, carrying plenty river sidements. The spoil banks appeared to be very heavily vegetated.
Crevasse # 1C	Very Good	None	700 ft X 75 ft by 6.0' NAVD 88	Appendix B	Good flow is being maintained by this crevasse. Soundings indicate good water depth is being maintained throughout its length. Strong current is also being maintained carrying much needed river sediments into the bays. Dredge spoil from the crevasse has vegetated nicely.
Crevasse # Alt. 2A	Very Good	None	732 ft X 75 ft by 8.0' NAVD 88	Appendix B	This crevasse maintains a good flow throughout its length. It has maintained its depth through along its length and appears to be carrying much needed river sediments into the interior marsh areas.
Crevasse # 2B	Very Good	None	500 ft X 75 ft by 6.0' NAVD 88	Appendix B	Currents are moderate to high in this crevasse. Evidence of sediments are being carrien into the marsh areas, and the spoil from the crevasse excavation has vegetated very heavily. This crevasse has also maintained it original depth throughout.
Crevasse # 2C	Very Good	None	2,000 ft X 75 ft by 6.0' NAVD 88	Appendix B	This crevasse is also one of the longest of the project and soundings show that it has maintained its constructed depth through its length. The spoil form the crevasse escavation has vegetated very nicely and there is plenty current to carry river sediments into the interior marsh areas.
Terraces	Very Good	Very Little	98 Terraces Length 200 ft. Width 52 ft. Height 3.5 ft. Total Length= 19,500 Lin. Ft.	Appendix B	The terraces have held up very well since they were costructed in the fall of 2006. There are a few that were built on the north side with soft / unsuitable material that have developed some washout areas in their perimeter; however, most of the terraces are in excellent condition and have vegetated heavily since the time that they were planted. Tides and the river were very high at the time of the inspection, but the terrace heights above the bay showed that they had maintained mostly all of their original elevations.Good current with plenty river sediments are obvious throughout the terrace field.